

## SEI Team Probes the Public Safety Value of Social Media at Massive Outdoor Music Festival



**July 18, 2013**—"Look around you," said Adam Miller. Thousands of people had gathered in front of a huge stage to enjoy one of their favorite acts. The surrounding landscape, equally alive with festivalgoers, was crowded with tents, campers, food vendors, and smaller performance venues. "Right now we're one of the largest cities in Pennsylvania."

Miller, director of the Huntingdon County, Pennsylvania, Emergency Management Agency, was talking about one of the largest outdoor musical festivals in the United States. The four-day event happens every summer in Miller's central-Pennsylvania backyard. It's his job to oversee public safety for the event, which draws an audience of more than 50,000, most of whom camp on the festival site's 600 acres. It's a remote site accessible only by two-lane highway and lacking significant communications infrastructure.

Ensuring the safety of all these festival goers, performers, vendors, volunteers, and others is no small task, and Miller is ever on the lookout for ways to make this challenge more manageable. Miller's research led him to the [Joint Interagency Field Exploration](#) (JIFX) in February. JIFX is a bi-annual event conducted to help maximize innovation and collaboration among the Department of Defense, government agencies, industry, universities, and first responders. At JIFX, when Miller viewed a demonstration of a number of tools developed by the SEI's [Advanced Mobile Systems Team](#), he knew that he and the SEI team needed to talk. The team researches technologies that support emergency responders and soldiers in the field who work in situations with limited computer resources, poor connections with networks, and highly diverse missions.

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"I'm looking at technology paths that can help support the broader prevention and response in mission spaces for the responder community," said Miller. "And, as we talked, I realized the SEI folks were knowledgeable about this mission space. They also had a very good understanding of what the responder mission will be in the long term, how it's evolving."

Miller and the Advanced Mobile Systems Team entered into deeper discussions and concluded this massive, outdoor musical festival would present an excellent opportunity to field test the team's tools and ideas. Specifically, given the event's scale and social nature, Miller and the Advanced Mobile Systems Team determined it would be an ideal test environment for a number of ideas the SEI team was developing around social media. Their concept was to gather and analyze social media data, such as Tweets, in real time and render it in ways that might support public safety activities.

"The thesis of this experiment was, 'Can we use social media to aide in public safety?'" said [Jeff Boleng](#), a senior member of the SEI technical staff serving on the Advanced Mobile Systems Team. "Studies have been published that show social media users can respond faster to some natural disaster incidents than even first responders—people on site begin immediately communicating information on social media that can actually be valuable to first responders."

"The challenge for us is cognitive overload resulting from the amount of information available to us in the social media space," noted Miller. "For us to be effective in basing actionable decisions on this broad piece of intelligence, we have to apply business rules to condense it into something that can be acted upon reasonably. There are so many different vectors of information out there that we want to capture them in real time because the moment of opportunity exists now to prevent what's going to happen in the future. We want to move further away from the reactive side of the spectrum and closer to the proactive, preventive side."

The Advanced Mobile Systems team moved rapidly from concept to development, taking just six weeks to produce a serviceable social media analysis tool ready for field testing at the festival. During research and development, they examined social media associated with the Boston Marathon bombings and Hurricane Sandy. The data from those events helped the team understand the kinds of social media information that might prove useful. Boleng explained their tool, dubbed "Edge Analytics," was designed to produce four kinds of information:

- *forensic information* to be used in post-incident analysis. Similar to the way in which closed-circuit television feeds assisted in the identification of the Boston Marathon bombing suspects, Edge Analytics collects social media communications into a database that can be analyzed for forensic support. The team will use this information to evaluate how well the Edge Analytics system performed and to inform improvements to the system.
- *reactive information* the team could analyze in near-real time when an incident was reported. On site, the team worked to coordinate incident reports with social media data, such as Tweets and attached photos. Such social media information can provide public safety officials more clarity about a given incident and help them make better decisions. The ability to mine this data in near-real time and to scale this ability to very large data volumes is a primary contribution of this research.
- *predictive information* extracted from an analysis of all event data from the Edge Analysis system and other sources. The Advanced Mobile Systems team will work to determine whether anything in the data might have provided a warning for the reported events and, if so, determine whether any system rules based on this data that could help predict an incident.

- *preventative information* that might help public safety officials make use of social media to head off problems before they have a chance to escalate. It can also be used to facilitate behavior modification to promote public safety.

An SEI team consisting of Boleng and SEI colleagues Joe Siebel, Gene Cahill, and Bill Anderson traveled to the festival. They set up in Miller's command post and, over the four days of the festival, collected and analyzed information using the Edge Analytics tool. They reviewed their findings with Miller and other public safety officials, and they also solicited feedback from these officials. System developers Soumya Simanta, Ben Bradshaw, and Derrick Karimi participated remotely from the SEI's Pittsburgh facility.

Miller was encouraged by early results. "As the SEI team is working on this proof of concept in my mission space today," reported Miller from the festival site, "I'm able to capture the flow of information in our working environment that affects the way we operate. And, if we can identify things that may threaten the efficiency of operations or potentially the safety of our guests, we'd like to be able to use that information."

In Miller's Emergency Management Agency command center, the SEI researchers monitored a number of social media data streams. Though the SEI team was there to collect data, experiment, and field test the Edge Analytics system, Miller noted the system provided real-world utility during a traffic-related incident.

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"We learned an electrified wire was down, and we got reports from the field that traffic was backing up. We engaged the Department of Transportation, first responders, individuals in the group, and then from here we pushed information from the application to festivalgoers all over the country to tell them 'Hey, don't come down this road. Use this alternate route.' We were taking advantage of all these streams to inform people and relieve traffic congestion."

The Edge Analytics tool helped the team process the raw social media streams into more meaningful and potentially actionable information. Specifically, the SEI team designed this version of Edge Analytics to produce sentiment analysis, topic modeling, entity identification, and keyword alerting.

Developer [Soumya Simanta](#) explained, "The sentiment analysis component associates a sentiment (positive or negative) by analyzing the content of individual Tweets. It can then take an aggregate of these sentiments over time. Sentiment analysis is very difficult to do Tweet by Tweet, but the global sentiment established over hundreds or thousands of Tweets is what matters." By tracking global sentiment, officials could not only gauge the general mood of a large crowd, but quickly notice changes in sentiment that could indicate a problem requiring further investigation.

“Topic modeling,” explained Simanta, “looks at all the Tweets that come in and categorizes them based on the content.” This gives public safety officials a view into what is important to the crowd, but can also detect potential problems. At this stage, topic modeling is not without problems and can be subject to false positives.

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“Entity identification does natural language analysis on every Tweet and tries to identify the entity in the Tweet,” said Simanta. The system determines entities such “Pittsburgh Steelers” by looking for nouns and phrases in a Tweet.

The team also examined geographically tagged data. By so doing, it was able to determine which Tweets were generated within a one-mile radius of the festival site. The primary advantage of analyzing geo-coded Tweets is that can provide analysts higher confidence that they came from people physically present at the location.

Simanta observed that the team is processing a huge volume of information that’s impossible for one person to analyze. “Our work here is trying to compress that information in a way to give you a bird’s eye view and then provide tools to filter out the noise and dig in.” Simanta added that the system was designed to find things of greater magnitude. “Our system would recognize, for instance, if a hundred people got sick in one hour.”

“We’re not reaching into closed space,” noted Miller. “We’re not reaching into private space. We’re taking what’s in the open source public domain and placing that against known elements we can pull in.”

The SEI’s [Bill Anderson](#) noted that it’s important to realize this tool is still in the early stages of development. But he’s encouraged by the reaction of Miller and others to the team’s efforts so far. “We had real validation from people directly at the tactical edge that this area of research—the large gathering of people challenge—is captivating. Our team is extremely grateful to Adam and his staff for affording us this opportunity to put our research and tools to the test in this real-world environment.”

For his part, Miller is happy to have met up with the SEI Advanced Mobile Systems team. He sees a lot of promise for public safety in the work the team is doing. “It’s a starting point, but we saw real-world examples of where efficiencies can be found. And this is only a small sample. Imagine if we were able to grow this thing. Our mission space is pretty clear. We’re trying to keep people safe, to allow them to go about their business unobstructed from the challenges in the environment they may face. We want to empower them to make the right decisions.”

For more information about the work of the SEI’s Advanced Mobile Systems Team, please visit [www.sei.cmu.edu/about/organization/software/solutions/mobile-systems.cfm](http://www.sei.cmu.edu/about/organization/software/solutions/mobile-systems.cfm).

